

Health Implications of Brief Inhalation of Diesel Emissions

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EHHI and CFE Policy Studies.

- EHHI –relationship between health effects and local exposures from combined motor vehicle sources.
- CFE – relationship between health effects and sources of exposure for all diesel fuels burned in specific regions.

Questions

- What is likelihood of exposure to a susceptible population?
- What are the potential health benefits from controlling diesel?
- What are sources of toxic risk?
- What do typical exposures look like?

Can We Assume That Compliance With Federal Clean Air Standards Protects Against Short Term Health Impacts?

- Standards are set by expert committees
- There are safety factors built in standards
- Standards must have a bright line for attainment
- Compliance is monitored

The contemporary Risk assumption:

- **“Average exposure level is directly related to the risk of a health outcome”**
- This is only correct under two conditions:
 - 1. When occurrence of a disease is closely related to cumulative exposure amounts such, as cancer rates in a moderately large population.
 - 2. When the average exposure level is a reliable surrogate of the typical higher levels of exposures.

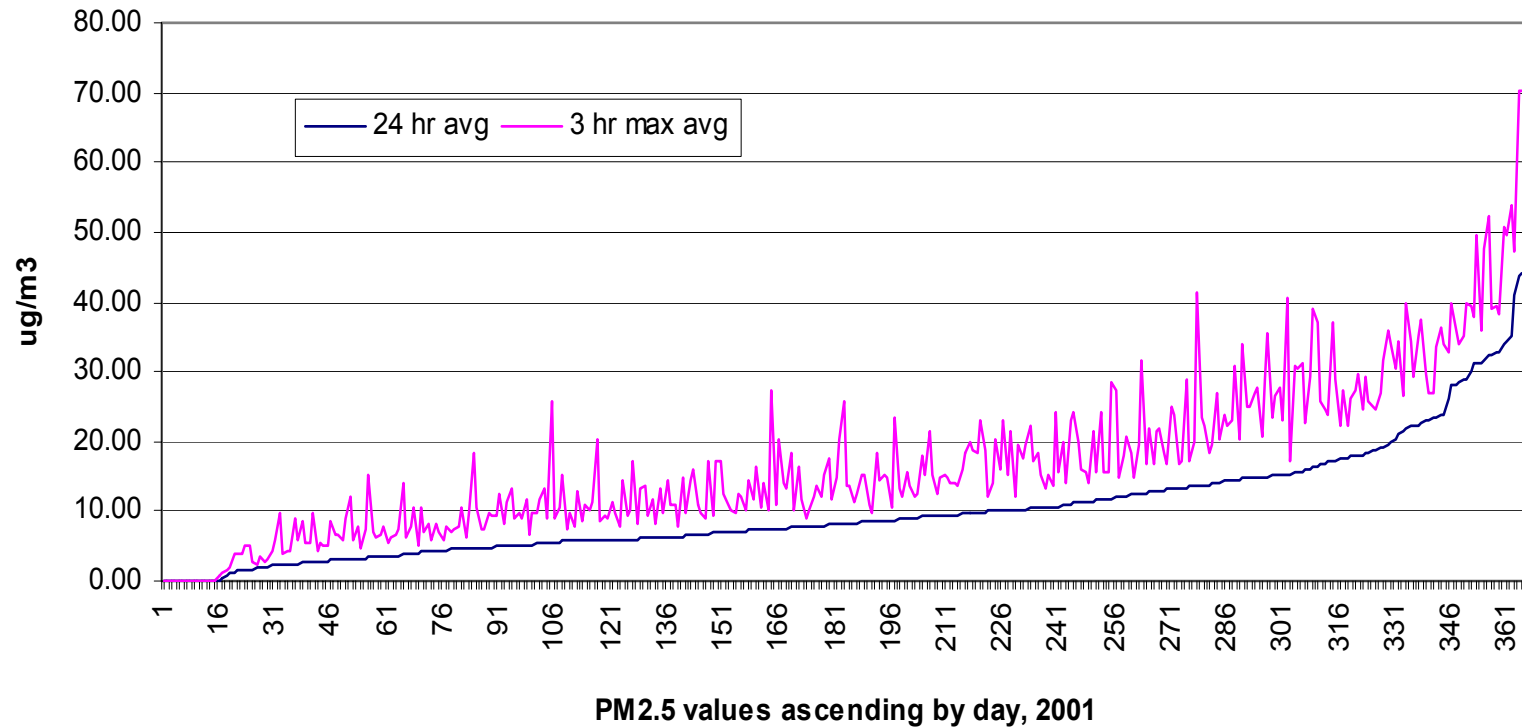
Short term idling exposures

- The contemporary risk assumption meets neither requirement - when considered from either the perspective of 4 health outcomes induced from the typical ranges of exposures or to emissions from diesel.

Implications

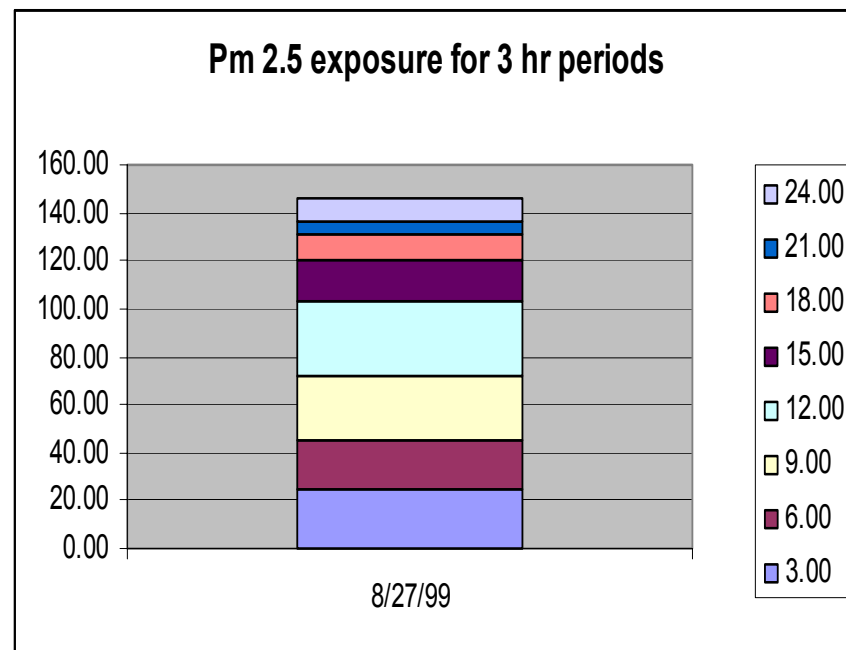
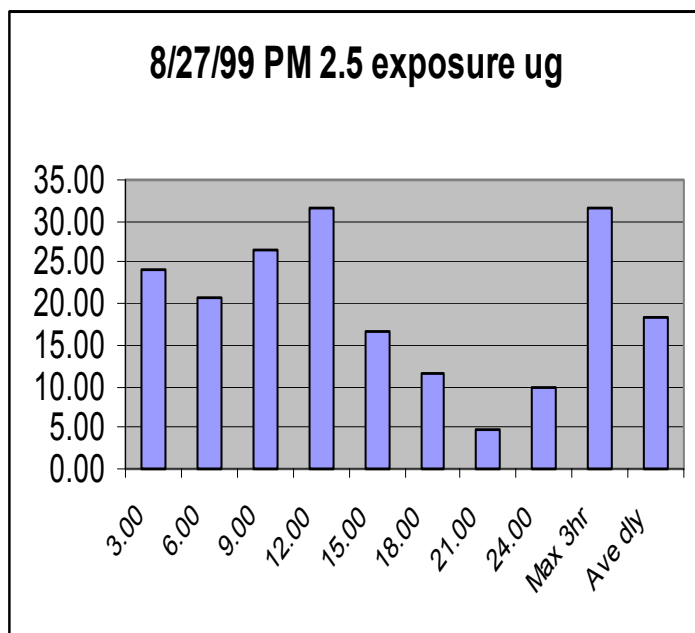
- The individual risk from short-term exposures to diesel air toxics is seriously underestimated when the standard risk assumption is applied to:
 - asthma attacks,
 - cardiovascular attacks, or
 - exacerbation of bronchial disease and
 - congestive obstructive pulmonary disease

Comparison of PM_{2.5} 24-hr avg and 3-hr max avg for New Haven CT site, 2001

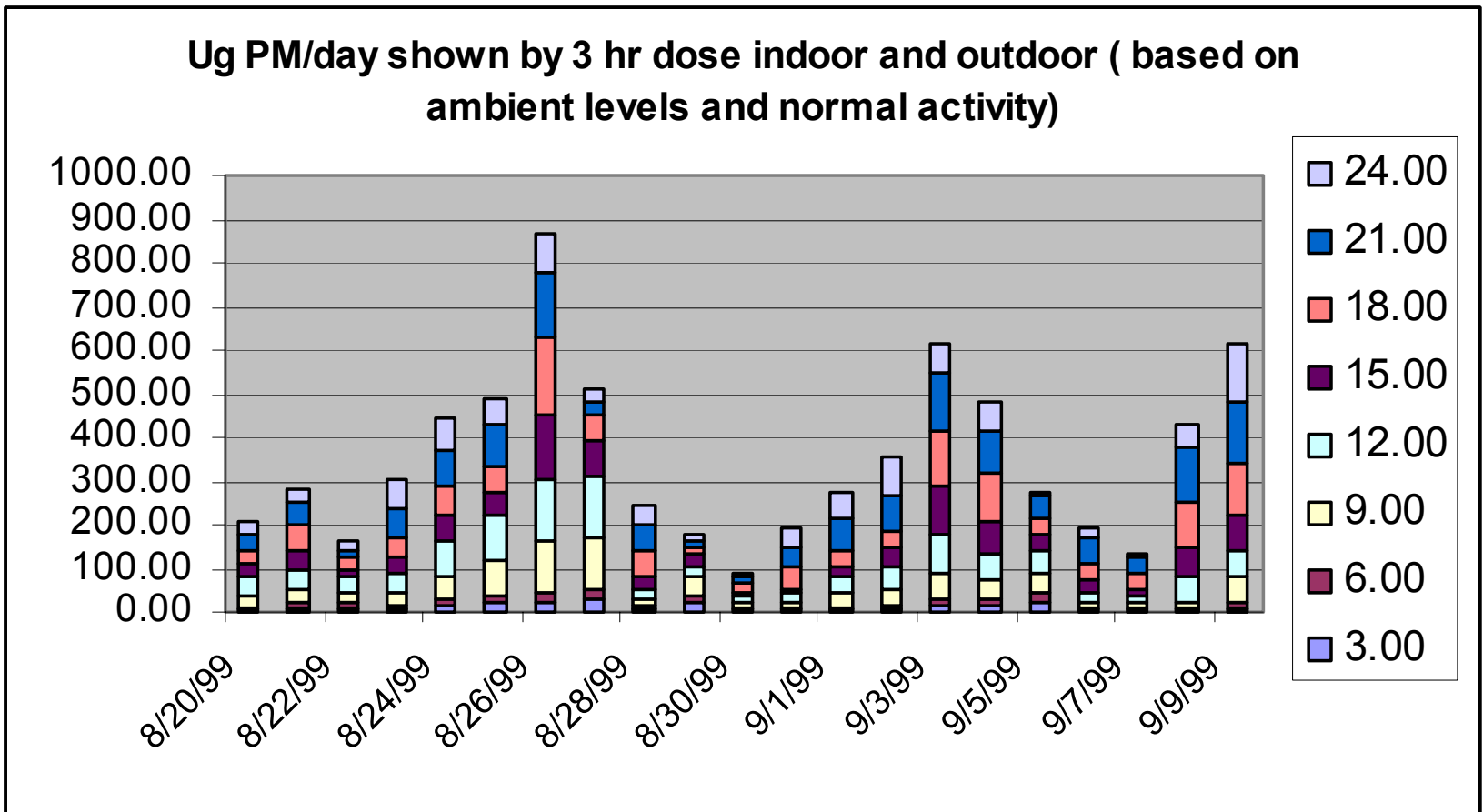


Analyzing fine PM data by comparing 3-hr exposure distributions to daily and annual averages reveals significant underestimation of potential health risk.

Difference in amount of exposure between times of day



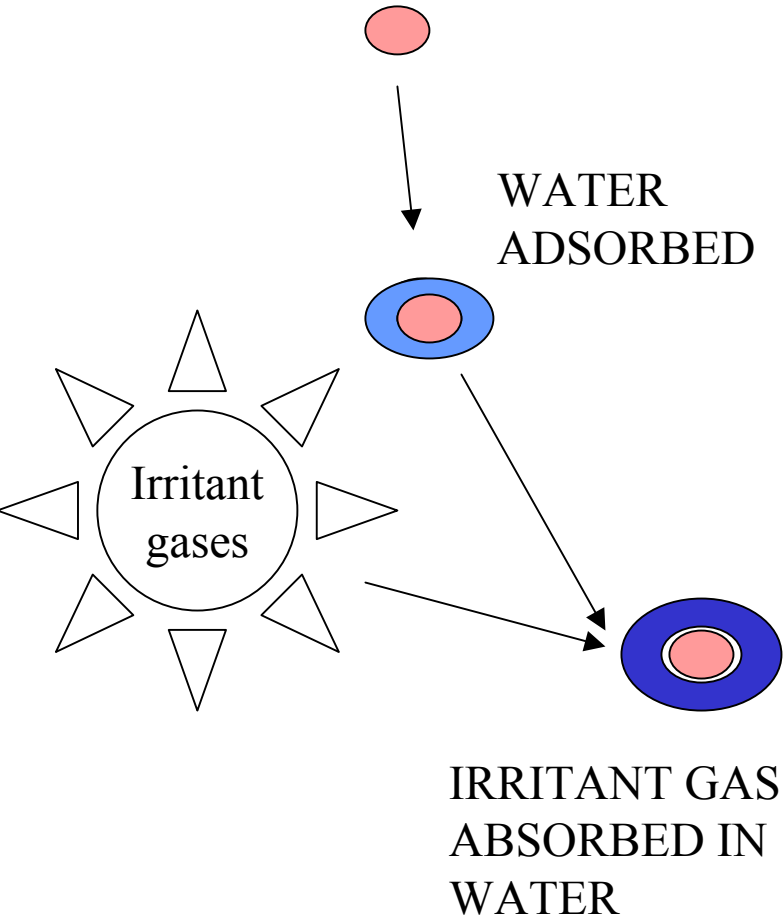
Actual inhaled dose varies between day, time of day, activity and location for child



How particles increase exposure of irritants to the deep lungs

DIESEL PARTICLE

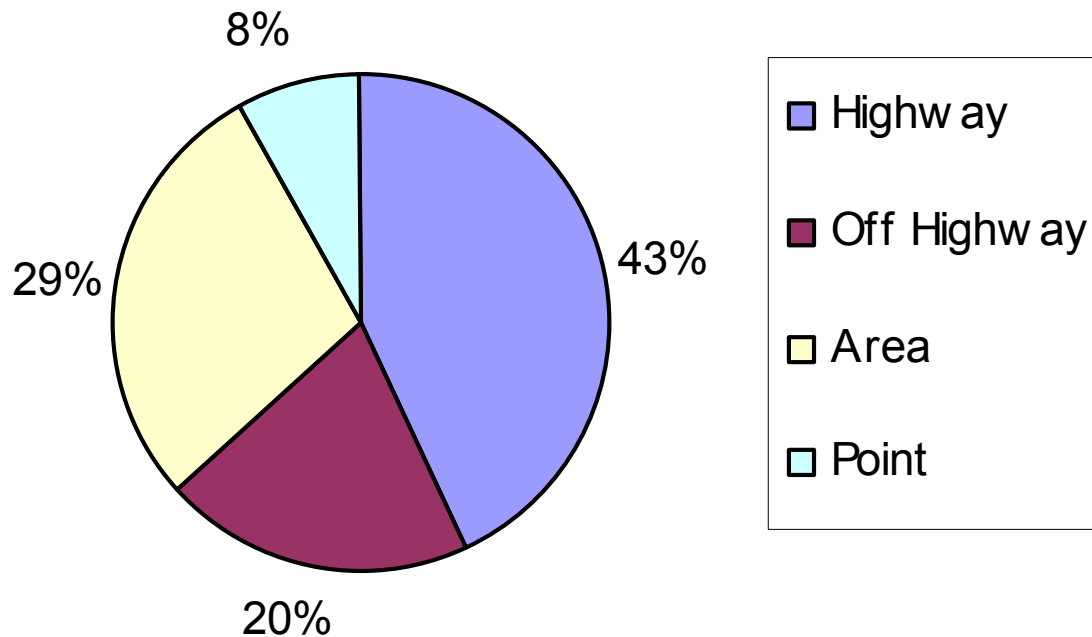
PM 2.5 RANGE



Deep lung exposure
to irritants



33 Air Toxics in Connecticut



Consider the different sources of toxics in outdoor air separately

- Transport from other regions
 - Fossil fuel and ozone
- Transport from the within the region
 - Utilities, fossil fuel and transportation
- Local sources such traffic and area sources
 - Transportation, off road commercial
- Immediate sources near the buildings
 - Vehicles diesel, pesticides and construction

Health actions from exposures of 2 hours or less.

- Peters et al. pm 2.5 & myocardial infarction
 - 1.48 odds ratio 2 hr after 25ug/m³ increase
 - 1.69 odds ratio 1 day after 20ug/m³ increase
- Gent et al. Severe asthma & O₃, pm 2.5
 - 35% increase wheeze 1 hr after 50ppb O₃ inc.
 - 47% increase in chest tightness 1 hr after.
 - 1.24 odds ratio Chest tightness 12-18ug/m³ pm

Fine Particulates

PM_{2.5} Spatial Distribution in NE

- Current monitoring network analyses average away PM_{2.5} variability.
- Are spatial and temporal factors (local sources, unique terrain, meteorology) influencing concentrations and creating PM gradients?
- If so, micro-scale exposure assessments must be refined.
- May reveal downward bias of health effects estimates: are missing populations at risk?

Number and % of adults and children with specific pre-existing disease conditions living in the northeastern U.S.

Age group and health condition	Prevalence rate (%)	Number of persons (millions)
≥18 yrs		31.19
Chronic bronchitis (past 12 months)	3.9	1.22
Hypertension (ever)	17.9	5.58
Heart disease (ever)	10.4	3.24
Diabetes (ever)	6.2	1.93
0-17 yrs		10.13
Respiratory allergies (past 12 months)	12.2	1.24
Asthma (ever)	14.8	1.50
Sinusitis (past 12 months)	14.7	4.58
Asthma (ever)	12.8	3.99

Hospitalizations and costs for Connecticut 1998

- 8,264 heart attacks
- 9,835 Congestive heart failures
- 3,715 Asthma
- 8,352 Chronic obstructive pulmonary diseases
- \$ 15,858 per heart attack
- \$9,256 per Congestive heart failure admission
- \$ 5,138 per asthma admission
- \$ 6,876 per Chronic obstructive pulmonary disease

Adult diesel soot impacts Bridgeport, Stamford, Norwalk

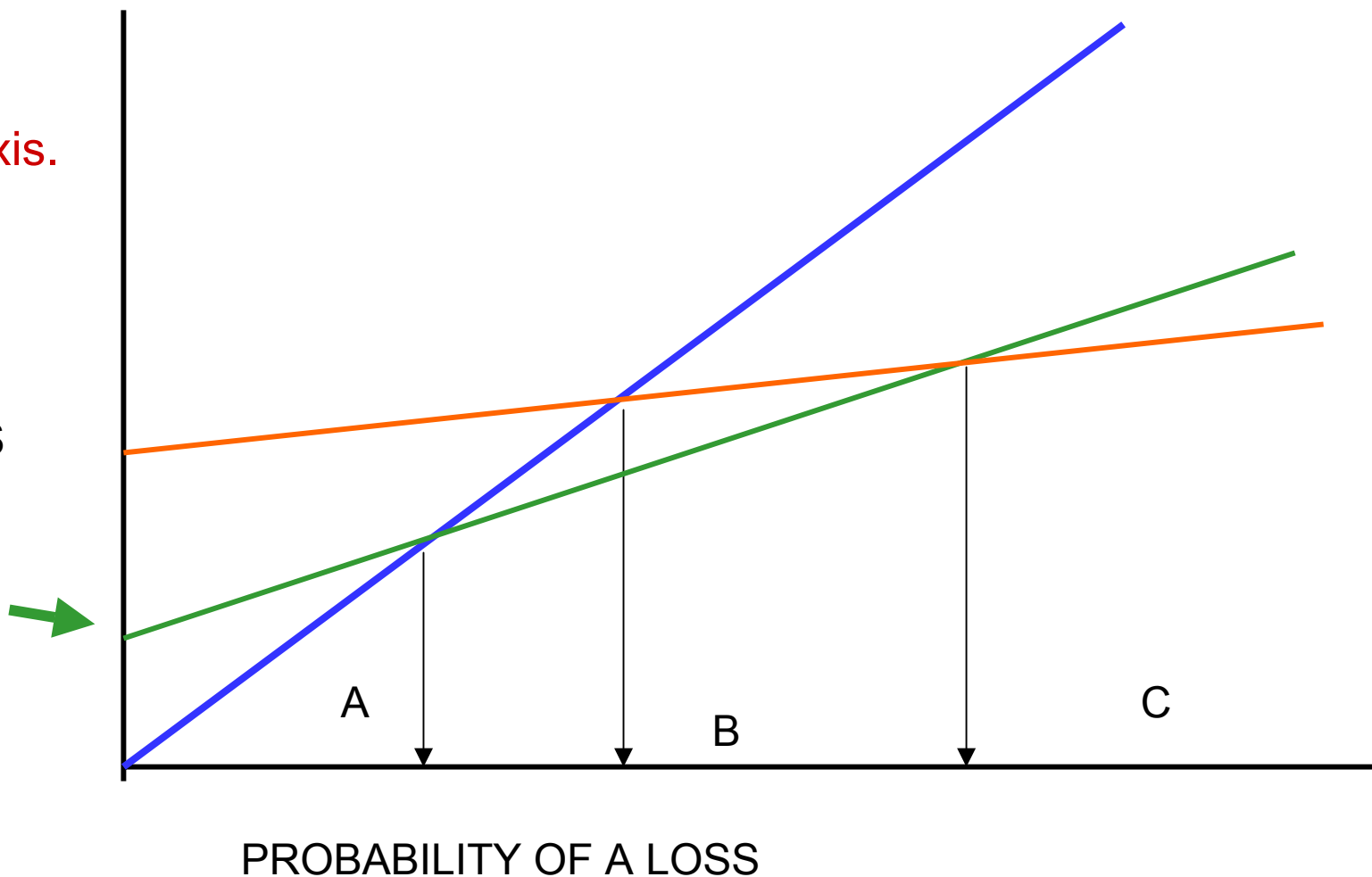
- 69 premature deaths
- 121 non fatal heart attacks
- 1,503 Asthma attacks
- 8,820 workdays lost
- 46 cases of chronic bronchitis

www.cat.us/projects/diesel

Scale Y axis.

\$ 10's MM

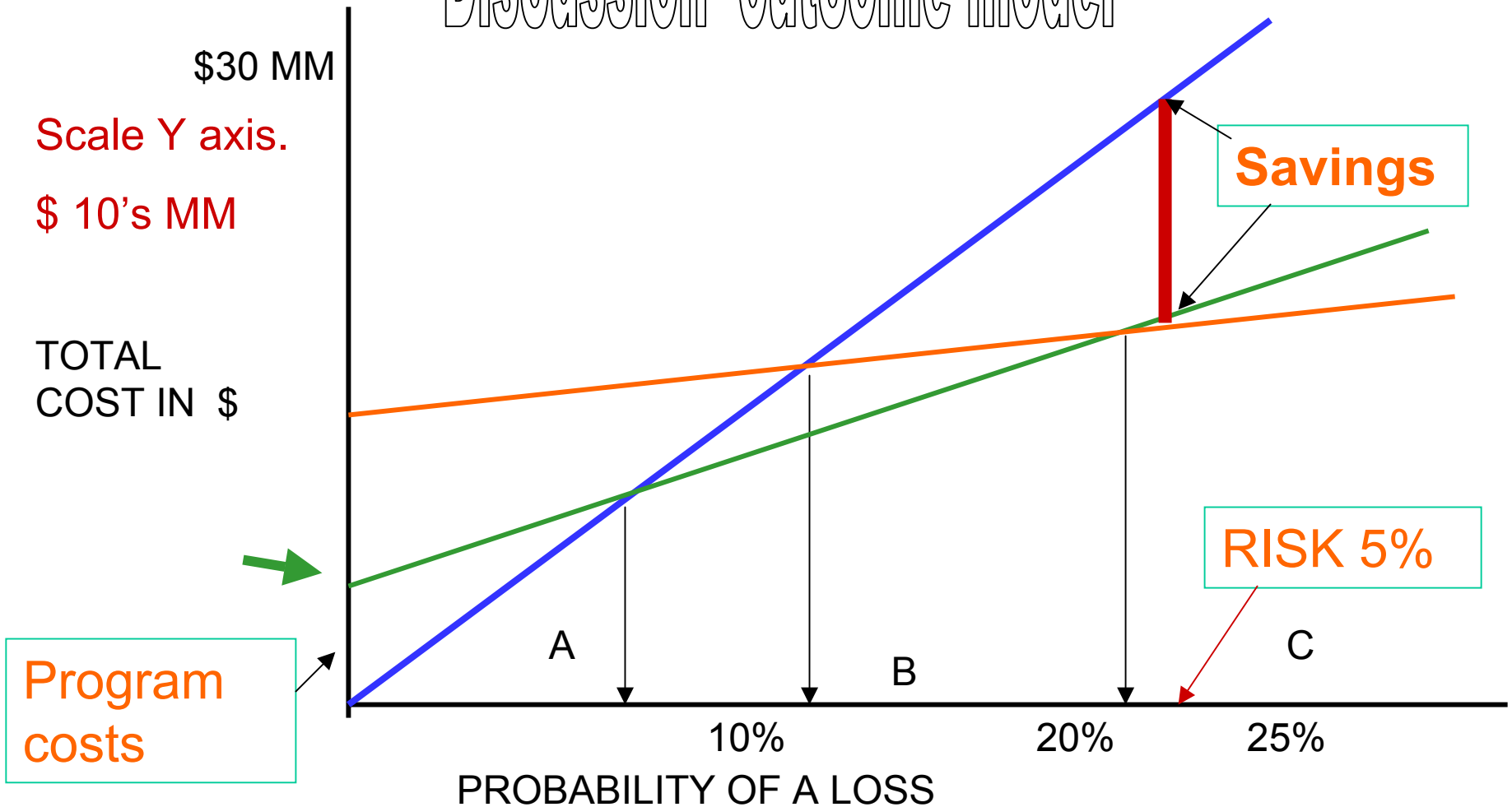
TOTAL
COST IN \$



Scale X axis;

Number of 6 hour episodes that exceed 30 ug/m³

Discussion outcome model



Scale X axis;

Number of 6 hour episodes that exceed 30 ug/m³

Summary

Four things needed are available,

- 1) characterization of PM 2.5 exposures,
- 2) the incidence and prevalence of the diseases related to PM 2.5,
- 3) plausible link between the exposures and disease and,
- 4) a systematic tool to evaluate practical policy decisions

Base policy judgments on plausible high end exposure levels

- Higher exposures are determined by proximity to strong sources
- Particulate matter severely increases exposures of other agents
- Actual health risks most closely linked to actual increases and not averages